THE PARTRIDGE BERRY

A REPORT

By

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ISSUED
UNDER THE AUTHORITY OF THE
DEPARTMENT OF AGRICULTURE AND MINES
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St. John's, Newfoundland,
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Hon. S. D. Blandford, Minister of Agriculture and Mines, St. John's.

Sir,—I have the honor to submit herewith for your consideration the report of my work in investigating the partridge berry, in which I have been occupied from the 1st of July to the present date.

I have endeavored to make the statement of my findings as complete as possible in the present state of my knowledge; as you will notice, however, I have indicated at several places in the report that I desire to reserve my report on certain points till a later date, that I may have the benefit of consulting authorities which have not been accessible here. I trust to be able to place in your hands supplementary reports on these points before the first of next year.

Permit me to point out that the work of this year is of little value in itself, unless followed up by the continuation of the investigation through another season. Only by so doing can you hope to arrive at a definite solution of the question of crop variation. The various methods of cultivation suggested should be given a practical trial. The pollination experiments should be repeated on a much larger scale. Investigation of the several fungus diseases should be continued until the successful tracing of the life-history of the parasite points the way to control.

In submitting this report, I have the honor to be, Sir,

Your obedient servant,

G. S. TORREY.

THE PARTRIDGE BERRY.

I.—THE PLANT.

The partridge-berry of Newfoundland is known botanically as Vaccinium Vitis-Idaea L., var. minus Lodd. The typical form of the plant is not found with us, but is a native of Europe. Our plant, the variety minus, distinguished by shorter stems and shorter and narrower leaves, is widely distributed, being found throughout northern North America, and also in Greenland and eastern Asia. The southern limit of its range coincides approximately with the boundary between Canada and the United States, though it extends farther southward in the mountains, and along the coast as far as northern Massachusetts.

Relationship.

The partridge-berry is a member of the heath family (Ericaceae), to which also belong many of our familiar plants of bog and barren: the Labrador tea (Ledum groenlandicum), the laurels (Kalmia spp.) the bog rosemary (Andromeda glaucophylla), and the capillaire berry (Chiogenes hispidula). In the genus Vaccinium are included not only the partridge-berry, but all our species of hurts or blueberries, and also the marshberry or small cranberry (Vaccinium Oxycoccus) and the large or American cranberry (V. macrocarpon).

Common Names.

Vaccinium Vitis-Idaea, var. minus is called by several common names. Newfoundlanders know it as the partridgeberry, while in Nova Scotia it passes as the foxberry, and in the United States as the mountain cranberry or rock cranberry. On the Chicago market it is called the lingen[illegible] The plant which is called the partridge-berry in the United States is an entirely different species, Mitchella repens, a member of the madder family (Rubiaceae).

Habit.

The partridge-berry is a trailing undershrub, with stems of two sorts: an underground stem or rootstock, which branches freely and by its growth serves to extend the area occupied by a plant; and the familiar aerial shoots, which are in reality lateral branches of the main stem or rootstock, and which serve to display the leaves, flowers, and fruit.

Aerial Shoots.

While the underground portions of the plant live for many years, the life of a shoot is generally four or five years, and is ordinarily brought to a close by the production of a cluster of berries. Since the production of berries is accompanied by the death of the terminal bud, the growth of the main shoot cannot continue thereafter, and ordinarily it drops its leaves during the ensuing winter and dies.

Basal Buds.

Although shoots are thus continually dying, the total number of shoots borne by a plant does not diminish, but rather increases. This is due to the development of buds borne upon the rootstock, one or two of which may be seen near the base of most shoots toward the end of summer. Each of

these rootstock buds is subtended by a small scale-like rudimentary leaf.

Flower Buds.

The shoot increases in length considerably each season except that in which it bears berries. At the end of the summer preceding bearing, a large bud is formed at the apex of the shoot, and this, when laid open, is found to contain the rudiments of the next year's blossom. At the beginning of the following spring, this bud expands, and the bud-axis elongates slightly, so as to separate the flower-buds, now fully formed. Since next year's flower-buds are already on the shoots at picking-time, it is evident that any injury to them will affect the crop by reducing the number of blossoms.

It is evident from these facts that at the close of the season three classes of shoots can be distinguished; those which have flowered during the summer just past and now bear berries; those which are terminated by the large flower-bud, and will bear next season's crop; and the one and two year-old shoots, which now have simply a small leaf-bud at the tip. These last will in the course of a few years be the berry-bearers, while the shoots which now are fruiting will have died.

Flowers.

The flowers begin to open in southern Newfoundland during the first week in July,and have nearly all dropped by the 25th of that month. The plants in sheltered situations are the first to bloom, while those that are exposed to the full force of the wind are later. A flower remains open for about a week, and occasionally for as much as two weeks, if it is not exposed to high winds or beating rains.

At opening time, the flowers, which are spirally arranged upon their axis, have twisted around so that as the upper part of the shoot assumes an inclined or horizontal position, the bells of all the flowers open downward. This is important, as it assists in the liberation of the pollen.

The number of flowers in a cluster varies from two to fifteen, the most common numbers being five and six.

POLLINATION.

In order to understand the mechanism of the flower, it is necessary to go into some details of structure.

Let us begin by cutting the flower lengthwise through the stalk. The conspicuous part of the flower is formed of two cups, the outer being the calyx, while the inner and larger one is the corolla, which is pinkish-white in the open flower. These parts, though showy, are not essential to the production of seed, which is the true purpose or function of the flower. Those organs which are essential are situated within the corolla, and are of two sorts. In the center is an assemblage of organs, known as the pistil, the basal part of which is a hollow case, the ovary. In this are small bodies, the ovules, which are the rudiments of seeds. Between the pistil and the corolla stands a circle of stamens. These produce in their box-like tips, a yellow powder, the pollen, which at flowering-time falls out through the long horn-like appendages. To produce seed, it is necessary that pollen grains should fall upon the receptive spot, the stigma, where the grain germinates, sending out a tube which penetrates into the ovary and comes in contact with the ovules. There the contents are discharged into the ovule, fertilizing it, and stimulating the growth of the ovule into a seed. This in turn causes changes in the ovary wall which result in the conversion of the ovary into a berry. Unless the pollen is brought into contact with the stigma, no seed, and consequently no berry will be formed, but the corolla will drop off, leaving the infertile ovary hanging on the stem, unchanged in size or substance. This too finally falls away. It is evident, therefore, that a thorough knowledge of the conditions which influence pollination is necessary to an understanding of the factors which control the size of the crop.

It is in general true (though not without exception), that plants are unable to produce fruit unless they have been pollinated: and often pollen from another plant, or from another flower

on the same plant is necessary (cross-pollination). Some flowers, however, are able to set fruit with their own pollen (self-pollination). In cases where cross-pollination is necessary or advantageous, transport of pollen is secured mainly through two agencies: the wind, and insect visitors, such as bees and butterflies.

A series of pollination experiments was undertaken upon the partridge-berry this season, in an effort to answer the following questions:

1. Is pollination necessary to the production of fruit?
2. If so, is self-pollination possible?
3. If cross-pollination exists, what agency transports the pollen?

POLLINATION EXPERIMENTS.

I wish to reserve detailed report on these experiments till a later date, suffice it to say (1) that pollination is absolutely necessary to fruit production; (2) that self-pollination, if not impossible, is certainly very rare, though pollination between flowers of the same cluster is frequent; (3) that the pollen is transported by the wind, and not by insects. The last conclusion is supported by the fact that pollen is present in the air at flowering-time. This can be shown by hanging a glass slide, thinly coated with vaseline, among the blossoms. After seven hours of exposure, such a slide showed grains of pollen of the shape characteristic of the partridge berry, which had been blown into the vaseline- layer in the same way that they are blown upon the sticky stigma of the plant. It is even possible in bright sunshine to see with the naked eye clouds of pollen discharged from the flowers when a bed of blossoms is brushed with the hand. Clearly, damp, calm weather during flowering would seriously interfere with the yield of berries by making transport of pollen difficult or impossible.

Soon after successful pollination results in fertilization of the ovules, the corolla drops away, and the ovary rapidly enlarges, so that within two weeks from the fall of the blossoms, it is more than half-grown. The changes then take place more slowly, and consist of further increase in size, development of color, and chemical changes in the pulp. The berries are ready to pick during the second week of September, and at that time are about three-eighths of an inch in diameter, of a deep crimson color, and mealy within. This season, (a very favorable one), about 30% of the blossoms produced fruit.

II. ENVIRONMENT OF THE PLANT

In order to understand the conditions under which the partridge-berry grows on the areas where it is commercially picked, the so-called barrens it is necessary to bear in mind that the vegetation of these tracts is at present in a process of transition. The conditions which are now found there have not always existed, nor will they continue indefinitely to exist.

For every situation, there is an ultimate type of vegetation, the last of a series of types, of which each prepares the way for the next. When this ultimate type is attained, a state of stable equilibrium exists, which can only be disturbed by disturbing the conditions of life in the given situation. In the case of the barrens, this ultimate type is the spruce and fir forest which existed over those areas at no very distant date. No other plants could displace that association so long as natural conditions prevailed, for the reason that the seeds of other plants were not fitted to germinate and grow in the deep forest shade. The destruction of the forest by fire did radically change the natural conditions. Instead of shade, there was open sunlight; instead of shelter, entire exposure to wind, and consequent increase of evaporation from the leaf-surface. The physical constitution, too, of the soil was altered by the burning out of a considerable part of the easily-combustible humus (leaf-mold); while the chemical ingredients remained the same as before, their relative quantities were altered, the incombustible mineral salts being present in a larger proportion.

It is not at all surprising that such a radical change in conditions should

result in a change in the character of the vegetation which is equally radical. Accordingly, when plants begin to re-appear upon the burned areas, we find not the shade-loving forest types, but species which are fitted to the new circumstances. Among the first to appear are the alder (**Alnus crispus**), the Arctic dewberry (**Rubus arcticus**), species of blueberries or hurts, the partridge-berry, and various lichens. The effect of the growth of these plants is exactly the reverse of that produced by the fire; they increase shade and shelter, and by their death and decay enrich the soil in leaf-mould, and consequently diminish the concentration of the mineral salts. These changes, if not carried too far are favorable to the plants; but they also permit other plants to enter the field of competition, which were excluded by the severity of the earlier conditions. Certain of these newcomers possess advantages, notably the shrubby habit, which enable them to shade out those of the first arrivals, like the partridge-berry, that are not similarly equipped; and we find, accordingly, the beds of partridge berry giving way to low thickets of Rhodora (**Rhododendron canadense**), Labrador tea (**Ledum groenlandicum**), sheep laurel (**Kalmia angustifolia**), and similar plants. These in turn prepare the way for denser thickets, until a return to the original forest is finally attained.

It is therefore not at all surprising to find several different classes of vegetation upon the moor-like expanses which are called the barrens. Large tracts which have been recently burned are almost without vegetation as yet, with only small quantities of alder and Arctic dewberry beginning to come in. Some of these burned tracts, however have suffered so severely from the fire that there is not sufficient soil to support even these plants; and years must elapse before the slow-forming agencies have built up again what by human carelessness was destroyed in a few hours. In other quarters a good turf has been formed, usually with partridge berries in abundance in the more open situations, while in some places the low thickets of heathy shrubs are already beginning to shade them out. Finally in the most sheltered places, we find dense thickets which already remind us strongly of the original forest conditions.

It is of course, important to discover at just what point the conditions are most favorable to the growth of the partridge berry, that we may arrest the changes there. The habitats which might be spoken of as its 'natural' ones (that is, those in which it is found permanently and not in the course of a transition, as at present on the barrens) are exposed headlands and rocky hill and mountain-tops, situations too bleak to permit a forest to establish itself. Certain portions of the barrens, to be sure, such as the hill-crests and cliffs, are habitats of this sort, and in such places the partridge berry and the plants that thrive with it in similar situations, will not be displaced. How does the growth of the plant in these situations compare with that of individuals growing in the shelter of alder-brushes on the lower southern and western slopes of the hills? While the plants of the bleak hill-top mature their berries earlier, their fruit is always small, and the shoots are barely able to rise above the turf of lichens which abounds in such places. In the sheltered spots, however, the berry, though ripening a little later, is often twice as large, and the shoots are larger and healthier in every way. It appears, then, that a certain amount of shelter is advantageous.

For the best development of the plant, however, a sufficiency of light and wind is as necessary as is shelter. If the wind is entirely cut off the chances of successful pollination are reduced; while too much shade causes the plant to spend its energies in increasing its leaf surface, to the exclusion of fruit production. All things considered, the best beds of berries are found on gentle slopes, to the south and west of alder bushes, where the low heathy thickets have not yet begun to intrude. These situations, unfortunately, are just the ones from which the plants are most likely to be driven by the entrance of the next members of the advancing series.

III.—THE SOIL.*

The depth of soil upon the barrens is nowhere very great. The country rock, a sandstone, outcrops frequently, and the ground is plentifully strewn with boulders, which appear to be fragments of the same rock which have been brought to the surface through the heaving action of the frost. It is rarely possible to dig two feet without encountering rock, and often one finds it much nearer the surface.

The soil is sharply differentiated by color into two layers. The upper, which composes the surface soil, is extremely light, and in texture resembles fine sawdust. Its color when dry is a reddish brown, which changes on wetting to a deep black. It is markedly lacking in plasticity when wetted, a fact which indicates a small content of clay; yet it is not easily reduced to a powder on account of the presence of considerable amounts of undecomposed vegetable matter. When boiled with a 10 per cent solution of caustic potash, it yields an opaque black solution, indicating a large percentage of humus or leaf-mould. It is strongly acid to litmus paper, turning the blue paper red at once when wetted. If ignited, the air-dried surface oil burns slowly without flame, leaving finally a small amount of incombustible ash. This is important as an indication of the damage which a fire may do to the soil. The greatest depth of surface soil hitherto observed is eleven inches.

Subsoil.

The second or subsoil layer is light-colored, but is nevertheless not entirely without humus, as is shown by the potash test. It is derived directly from the underlying rock by the decomposition of the latter; and though it is of comparatively fine texture in its upper layers, it grades off downward into larger and larger sizes, until it is impossible to say just where the 'rotten-stone' ends, and the solid rock begins. The decomposition of the country rock is continually replenishing the subsoil from below, while the penetration of roots into its upper layers, which is easily to be observed, aids its decomposition, and their decay increases its content of humus, thus gradually converting it into surface soil.

There is one soil condition upon the barrens which calls for special comment: the crusty patches, often dozens of square feet in extent. Strictly speaking, this is not a soil condition, but is the result of the growth of certain encrusting lichens. The earth is covered with a brittle crust, which cracks into small clods. Since this lichen is able to exclude all other plants from the area which it occupies, it is an enemy to be reckoned with in cultivating the partridge-berry.

IV.—INSECT AND FUNGOUS ENMIES.

I desire to reserve detailed report upon this important subject until a later date; it is, however, possible to make a preliminary statement at present.

Insects.

Under existing conditions, the injury inflicted upon the partridge-berry by insects is trifling. Two injurious insects have been seen, one of which attacks the flower, and the other the fruit. The flower worm attacks the blossom while it is still in the bud, and eats out the pistil and stamens, the essential organs of the flower. If this worm occurred in abundance, it would be a serious pest, but not more than a dozen cases were observed during the flowering season. The fruit worm attacks the berry just before picking time, eating out considerable parts of the pulp, and often passing from one berry to another of the same cluster. This worm is somewhat more prevalent than the flower worm, but in most localities does no great damage. It is reported, however, that plants near the lighthouse at Western Bay Head are so in-

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* This description applies to the conditions at Old Perlican where the season's work was carried on. It is probable that there is little if any variation on other barrens except as to the kind of rock.

fested as not to be worth picking. There is no profitable means of combatting these insects upon plants in the wild state.

Fungous diseases.

A fungous disease is caused by the presence in the plant tissue of a fungus, which is a plant of a lower type. Its activity may be roughly compared to that of bacteria in producing disease in animal bodies. There are two abundant fungous diseases of the partridge-berry, at least one of which is of present interest from a commercial point of view; and one or two minor ones.

Club-Shoot.

A club-shoot disease is found not only upon the partridge berry, but upon the low blueberry (**Vaccinium pennsylvanicum**.) Its presence causes a great increase in the thickness of the cortical layer of the bark; so that the shoot is abnormally lengthened. At the same time it assumes a handsome pink color, the whole presenting a distinctive and easily recognized appearance. These club-shoots are produced from basal buds, and usually arise in numbers in the infected region forming a 'witch's broom.' Unlike the undiseased shoots the club-shoots endure for one season only, though in that time they make a growth in length which is often double that attained by the normal shoots in their life of four or five years. Toward the end of the summer they turn a dark brown, and during the winter the bark shrinks more rapidly than the central cylinder of wood, and cracks around the stem in horizontal lines, so that last year's diseased shoots look like strings of cylindrical beads on a chain. The hyphae or vegetative threads of the fungus are easily seen in the infected cortex when the latter is sectioned and examined microscopically. At present it is impossible to make any statement regarding the nature of the fungus, or the mode of infection. The fact that infected shoots always arise from basal buds suggests that perhaps infection may take place beneath the soil.

It goes without saying that since the fungus stimulates the plant to produce roughly ten times as much tissue as it would normally form in a season its presence prevents the use of the plant's energies in the formation of fruit to a very important extent.

Leaf-Spot.

A leaf and fruit-spot disease is even more prevalent. The infection first appears upon the leaves in the form of white patches which later turn black. A section of the leaf shows no fungus hyphae, but simply a decay of the cells which lie just beneath the upper epidermis. This decay continues to spread inward, until it reaches the lower surface of the leaf, producing a hole which extends entirely through the leaf, except for the thick cuticle on the upper surface, which usually remains intact. When the berry is about half-formed, dark spots appear upon its surface, and inspection of the tissue shows them to be similar to the spots upon the leaf. As the berry ripens they increase in size, and often crack. While the connection of the fruit spot with the berry spot is not proven, yet it is beyond reasonable doubt, since the lesions are strikingly similar, and occur upon the same shoots. So far as observed, no fruit is produced by the fungus in the course of the disease, and the determination of the nature of the parasite awaits cultural study. This disease is at present much the most important of the two, since it affects the marketed fruit.

While the enemies just mentioned are not now of great commercial importance, yet they should be thoroughly studied if the berry is to be brought into cultivation, since under such conditions diseases of all kinds are likely to be more prevalent than in nature. Of course they are also much more easily controlled.

V.—PICKING AND PACKING.

The Act.

The berry crop has been seriously injured in years past by over eager pickers, who insisted upon tramping over the grounds and knocking the berries from the plants before they were ripe. This evil has been remed-

ied, by the passage this spring, in response to numerous petitions, of the act entitled: 'An Act for the Protection of the Growth of Partridge Berries,' which makes it a penal offence to pick or sell berries before a date to be set by the Minister of Agriculture and Mines. The working of the Act this year has given general satisfaction. There was at first some complaint that the date set, the 12th of September, was too late; but it proved to be quite early enough. Since the act was passed at the instance of the people, it has been very well observed; one or two violations only have been reported, and are being dealt with by the proper authorities.

Picking.

Berry-picking was formerly a woman's industry; but the prices offered to the pickers have been sufficient in recent years to attract men; and this year the poor fishery has brought an unusually large number to the berry-grounds. It is customary for the whole family to start off in the early morning for a day of picking, taking with them provisions which they eat around a fire at noon. Considerable trouble has been experienced in the past from carelessness in extinguishing these fires; but this year fire notices were freely posted in the berry-picking settlements, with the result that no fires have come to my knowledge as yet. It is often necessary to go several miles in from the settlements to find good spots, and the day's pack, amounting for an average picker to ten gallons, or for a good one, to fifteen, is carried out in bags. The berries as first picked contain leaves and dirt, and before they are saleable it is necessary for the pickers to wait for a windy day to winnow them. This is accomplished simply by spreading a cloth in an exposed place, and pouring the berries upon it from a pail held at arm's length above the head. The clean berries are now carried to the local buyers, who pack them with water in twenty gallon barrels.

Inspection. Shrinkage.

The Board of Trade at St. John's has found it necessary on account of complaints of shortage from buyers on the foreign markets, to inspect all berries as they arrive from the Outports. Each barrel is opened, and those that show shortage are filled up. All parties agree that even when all precautions are taken, 20 gallons put into a barrel on the grounds will turn out only 18½ or 19 gallons a few weeks later at St. John's. Much comment has been made by the local buyers that they were saddled with this loss which had come out of their commission, though not chargeable to their fault. I find, however, that it is at present customary for the dealers in St. John's to allow for this usual shrinkage in the price which they offer to the local buyers, and to make up the shortage at the time of inspection, a practice which is fair to all parties, since the local buyer's commission depends on the quantity of berries which he handles, and is independent of the price which he has to pay the pickers. In some cases, two quotations are made to the local buyer by the merchant; a lower rate at which the merchant will assume the loss due to shrinkage, and a higher one, 'subject to inspection.'

Cause of Normal Shrinkage.

The cause of this loss is probably not a crushing or compression of the berry, as seems to be generally supposed, but rather a settling down of the berries to fill the space as compactly as possible. If a gallon as usually measured by the local dealer, who pours the berries in quickly and levels off the top, be tapped sharply on the table two or three times, the berries will settle to about 95-97 per cent of the volume of the gallon. The process of dumping a barrel of berries into a twenty-gallon measure, as is done at the time of inspection, produces an effect very similar to the tapping. The difficulty is that the contents of a gallon measure, and one-twentieth of the contents of a twenty-gallon measure, are different volumes in the sense that they displace different amounts of water, for the reasons just stated.

Aside from this normal shrinkage which is to be expected and allowed for, very considerable shrinkages are caused by allowing the berries to

stand without water after they have been measured or by packing berries into the barrels without first placing a coup e of ga lons in the bottom; these involve an actual crushing of the berry. They are due solely to the carelessness of the packer, and the resultant loss is justly charged to him.

Winnowing Machines.

It is unfortunate that the pickers are obliged to keep the berries in bags or boxes for several days while waiting for a wind to winnow them. During this time, the berries are losing both weight and volume by the evaporation of water, and the picker is consequently losing money. The introduction of winnowing machines, such as are in use for cleaning cranberries, would make it possible to get the berries into barrels on the day of picking; and berries so packed might sell as a fancy article, commanding a few cents above the ordinary market price.

Mechanical Pickers.

All picking is done by hand at the present time; and it must be admitted that under the existing conditions, the prospects of devising a successful mechanical picker are exceeding slim. The ground is uneven, and the berries are so intermingled with woody-stemmed shrubs and buried in lichens that the intelligence and adaptability of a human hand is needed to get them off the vines with the necessary rapidity. Two pickers were given a trial at Old Perlican this season. One was a cranberry picker from Cape Cod. The cover is hinged and when the fruiting tips have been brought between the wires, by a forward motion of the picker, the pressure of the thumb on the bar closes the cover and prevents the berries from flying out as an upward pull separates them from the plants. This closing feature is a valuable one; but the picker is quite useless on account of its width; it digs up a great deal of moss without getting many berries. If made about three inches wide—one-third its present width, it would work better; but at best it is expensive and complicated.

The other was a small tin picker, designed in this country in competition for a prize offered at one of the Agricultural Exhibitions. The berries are lifted from the vines by prongs which in the original form of the implement were straight, and a backward tilt of the picker carries them over the guard, so that another horizontal stroke can be taken without loss of fruit. When the picker is full, it is reversed, and the berries are poured through the opening. This design is more promising than the first one, but many berries are lost by flying out when the pull of the picker separates them from the vines. An hour's picking in a favorable place with this device yielded barely half a gallon, whereas a good hand picker would secure a gallon in that time.

I am indebted to the kindness of Mr. W. A. Munn for the opportunity of trying these pickers.

Any picker built like a rake rather than like a scoop seems out of the question on account of the moss and lichens in which the berry plants grow. Fruit raked from the vines falls down among the stems and cannot be secured.

It seems necessary, therefore, to abandon temporarily the idea of a mechanical picker. Under the changed conditions which cultivation would produce, the question would assume an entirely different and much more favorable aspect. In the meantime, evthe design and trial of pickers intended to be used under existing difficulties.

VI.—VARIATION IN SIZE OF CROP

One of the principal objects of the present investigation was to discover, if possible, the causes of variation in the amount of the crop. As was pointed out at the commencement of the work, a definite solution of this problem can be reached only by comparing the conditions which result in a large crop with those which produce a small one. The present season, moreover, has (unfortunately, from this point of view) been an exceptionally good one, and has offered little opportunity to discover factors ad-

verse to the production of the crop. It is, however, possible to suggest one or two causes of shortage.

Many plants, of which the apple is perhaps the most familiar example, have the habit of bearing a heavy crop of fruit one year, and little or none the next. This is to be explained by the drain which the production of flowers and fruit makes upon the reserve food of the plant, leaving but a small surplus for the formation of next year's flower-buds, a process which must take place contemporaneously with the building up of fruit tissue. In the 'off' year, however, this drain is relatively trifling, and the number of flower-buds formed is proportionately great. It is probable that a similar but less pronounced condition in the partridge-berry is partially responsible for variation in the crop. No remedy for this exists while the plants are in the wild state; in cultivation it might be possible to mow the flowering tips from alternate sides of a field in alternate years, thus allowing one side to bear this year, let us say, while the other side is kept from bearing, and consequently is encouraged to form a large number of flower buds for next year. This suggestion is put forward with some hesitation, as it is not yet backed by any experimental or observational data.

Weather.

A more likely cause of crop failure is prevalence of wet calm weather in the flowering season, preventing the transport of pollen, and consequently the setting of the fruit. A possible remedy is the keeping of bees, which by their visits to the blossoms will transport the pollen and secure the fertilization of the ovules. Upon the practicability of bee-keeping in Newfoundland, I desire to reserve report until a later date.

A possible but unlikely cause of shortage is an epidemic of one of the fungous diseases or insect pests to which the plant is now liable. The possibility of reduction of the crop by injury to the flower-buds in picking time exists, but it may under present conditions be safely left out of consideration.

VII.—CULTIVATION.

As I have from time to time pointed out in the foregoing pages, there are several sorts of conditions in the environment of the partridge-berry which must go unremedied until we have it under cultivation and under our control. Moreover, the plant is being gradually ousted from the barrens, and if the crops are not to be diminished on that account in the future, we must resort either to cultivation, or else burn the barrens again and start afresh. The second alternative is undesirable, for we run serious risk of overdoing things, and by burning a little too deeply, acquiring, not a new berry-barren but a tract of bare rock. Cultivation should therefore be tried, and it is the purpose of the present section to give as full directions for trial as possible.

The Soil.

The soil in which cultivation is most likely to be successful is of course that in which the plant grows naturally, the soil of the barrens; and while it is not necessarily true that the plant will grow in that soil only and in no other, the ensuing directions are drawn to fit that soil.

Selection of Ground.

The spot selected for the trial ground should be on a gentle slope, and should face toward the sun and away from the prevailing winds. Observe on which side of the alder-bushes the berry-plants are most abundant and thrifty, and choose a slope which has the same direction. It is now necessary to make sure that the soil is sufficiently deep over the required area to permit cultivation. This can be ascertained by the use of a probe. An ordinary crow-bar is convenient but a pick-axe will answer very well. This should be thrust into the ground at frequent intervals, and no area should be selected which does not possess, over most of its surface, at least six inches between the top of the turf and the rock.

Clearing.

After a suitable spot of ground has been chosen, it should be cleared of

shrubs by a bush-scythe or grubhoe, and the turf would then be cut into strips with an axe and removed with a mattock. In most cases it will be impossible to remove all the rootstocks by this method without taking off too much soil; some of those which remain can be grubbed out with a rake.

Planting.

This done, the spot is ready for planting, which should be done as early as possible in the spring of the year, probably best about the first of June. The cuttings to be planted can be prepared the preceding autumn and stored over the winter. This insures the presence in the plant of the entire store of reserve food accumulated during the past season, and makes a rapid and vigorous start possible. To make the cuttings, select a spot where the plants are free from disease and vigorous, and grub up the turf in patches about a foot square. Vigorous shaking will loosen the dirt from the rootstocks, and enable the partridgeberry plants to be separated from any others which may be growing with them. The plants thus obtained may be packed in earth in barrels, and stored in a cold place over winter. At planting time the rootstocks are cut up, and one aerial shoot with enough rootstock to show one or two basal buds forms a cutting.

Dibbling.

Several methods of planting are possible, and experiment alone can determine which is the most expedient. The simplest method is to mark out the ground in 18-inch squares, and with a dibble, which is simply a sharp stick about ¾ inch in diameter, to make a hole at each intersection of the marking lines. A couple of cuttings are now thrust into each hole leaving the tips only above ground, and the holes are closed by again thrusting the dibble into the ground close to the hole, and swinging it over so as to press the sides of the hole together around the cuttings. This work should be done when the soil is wet, as it is too light when dry to be pressed into good contact with the plants.

Other Methods.

It may be more advisable to modify the texture of the soil by digging or plowing it over, so as to mix the subsoil with the light surface soil. This is the practice of the people in making gardens. The cuttings can then be dibbled in as before, or a furrow can be made in which they may be dropped. The furrow may then be closed with a plow or hoe. The admixture of beach sand with the surface soil should also be tried, though it is likely to be unprofitable on account of expense. The effect of surface sanding, such as is practiced in the culture of cranberries is also worth a trial. In this connection, cuttings may be sown broadcast upon the field, and then covered with a layer of an inch or two of sand. If planting cuttings should prove unsuccessful (an unlikely contingency) bits of turf from spots where the growth of partridgeberry is pure or nearly so, may be set at intervals of 18 inches upon the field.

It is best at present to say nothing about the use of fertilizers, or methods of fighting plants which intrude into the trial ground. These questions can better be attacked when the plant is actually being cultivated.

I desire to reserve till a later date report on the possibility of cultivation on other soils. This is an interesting possibility, and might become very important if it proved possible to cultivate the plant on an artificial soil-mixture in proximity to the markets.